The Impact of a Fracking Ban on Shale Production and the Economy

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ABOUT THIS PAPER

Oil and gas production from the U.S. petroleum resource base has experienced an unprecedented expansion in output which has now positioned the U.S. as the world's largest oil and gas producer. The North American petroleum production platform is soon to become a net oil and gas exporter to the world market. This rapid expansion in oil and gas production has enhanced U.S. energy security, provided greater stability to the world oil market, and conveyed sustained economic benefits to the national economy. The expansion in output has been possible through a series of advances in extraction technology including the use of hydraulic fracturing which permits oil and gas production from so-called source rock.

Concerns over carbon emissions from sustained increases in domestic oil and gas production has now been reflected in the 2020 Presidential race, with some candidates and many public interest groups calling for an end to hydraulic fracturing. Operationally, these initiatives would include a ban on oil and gas development on public lands, prohibition of new infrastructure, such as pipelines, export terminals and even refineries. This effort, championed by several Democratic candidates for President would include features of so-called Green New Deal (GND) to quickly move that national energy complex to a fully renewable fuel system.

In this paper, EPRINC fellow Michael Lynch, explores the economic consequences of policies aimed at severely reducing U.S. oil and gas production. Such an estimate is important because whatever the merits (benefits) from reducing carbon emissions through oil and gas production constraints, policy makers will have to confront the costs and public acceptance of such a policy.

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ABOUT EPRINC

The Energy Policy Research Foundation, Inc. (EPRINC) was incorporated in 1944 as a not- for-profit organization that studies energy economics with special emphasis on the production, distribution, and processing of oil and gas resources. It is known internationally for providing objective analysis of energy issues.

The Foundation researches and publishes reports on all aspects of the petroleum industry which are made available free of charge to all interested organizations and individuals. It also provides analysis for quotation and background information to the media. EPRINC has been called on to testify before Congress on many occasions, and it briefs government officials and legislators, and provides written background materials on request. Additionally, EPRINC has been a source of expertise for numerous GAO energy-related studies and has provided its expertise to virtually every National Petroleum Council study of petroleum issues. EPRINC receives undirected research support from the private sector and foundations, and it has undertaken directed research from the U.S. government from both the U.S. Department of Energy and the U.S. Department of Defense.

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A number of presidential candidates have committed to banning the use of hydraulic fracturing for the extraction oil and gas from U.S. petroleum production provinces. Given the importance of this extraction technique, a large sustained decline in domestic oil and gas production would quickly follow. The report concludes that a decline in oil liquids of 6 mb/d likely would occur by the end of 2022 and natural gas production would fall by an estimated 11 bcf/d. Such a sharp decline would be difficult to replace.

Figure ES-1 shows the sharp rise in tight oil production as a result of fracking and demonstrates the tight oil share of the total production. Figure ES-2 contains the projected trend in U.S. shale oil production in the two years after such a ban takes place and would be accompanied by an increase of $150 billion in U.S. oil imports in the unlikely event that the production loss would not bring about an increase in world oil prices. In a more likely case of at least a $20/barrel increase in oil prices, the U.S. oil trade deficit would grow by $200 billion over the current level and consumers would have to spend an extra $400 billion for their oil and gas.

Figure ES-1
U.S. Crude Production (mb/d)

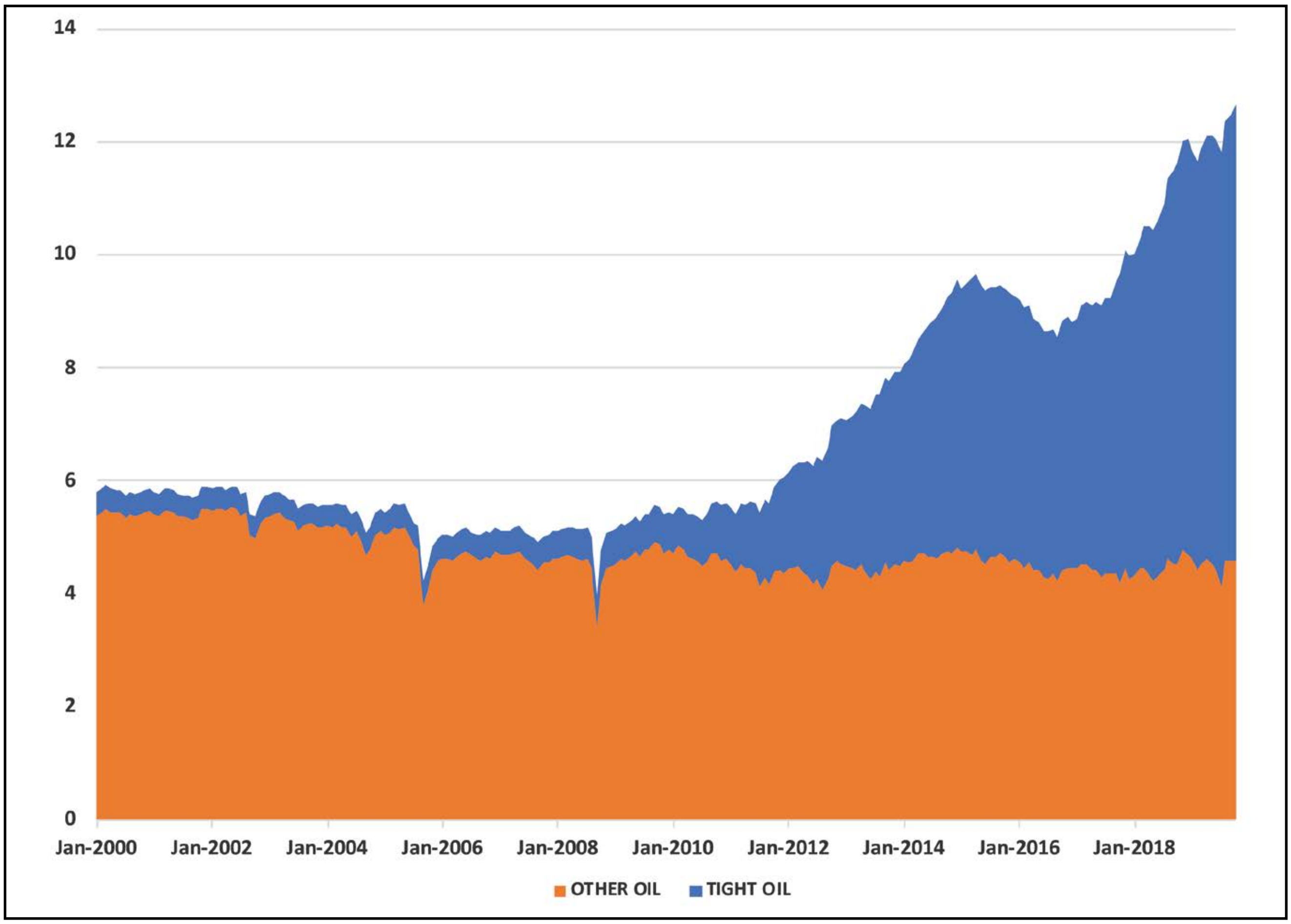
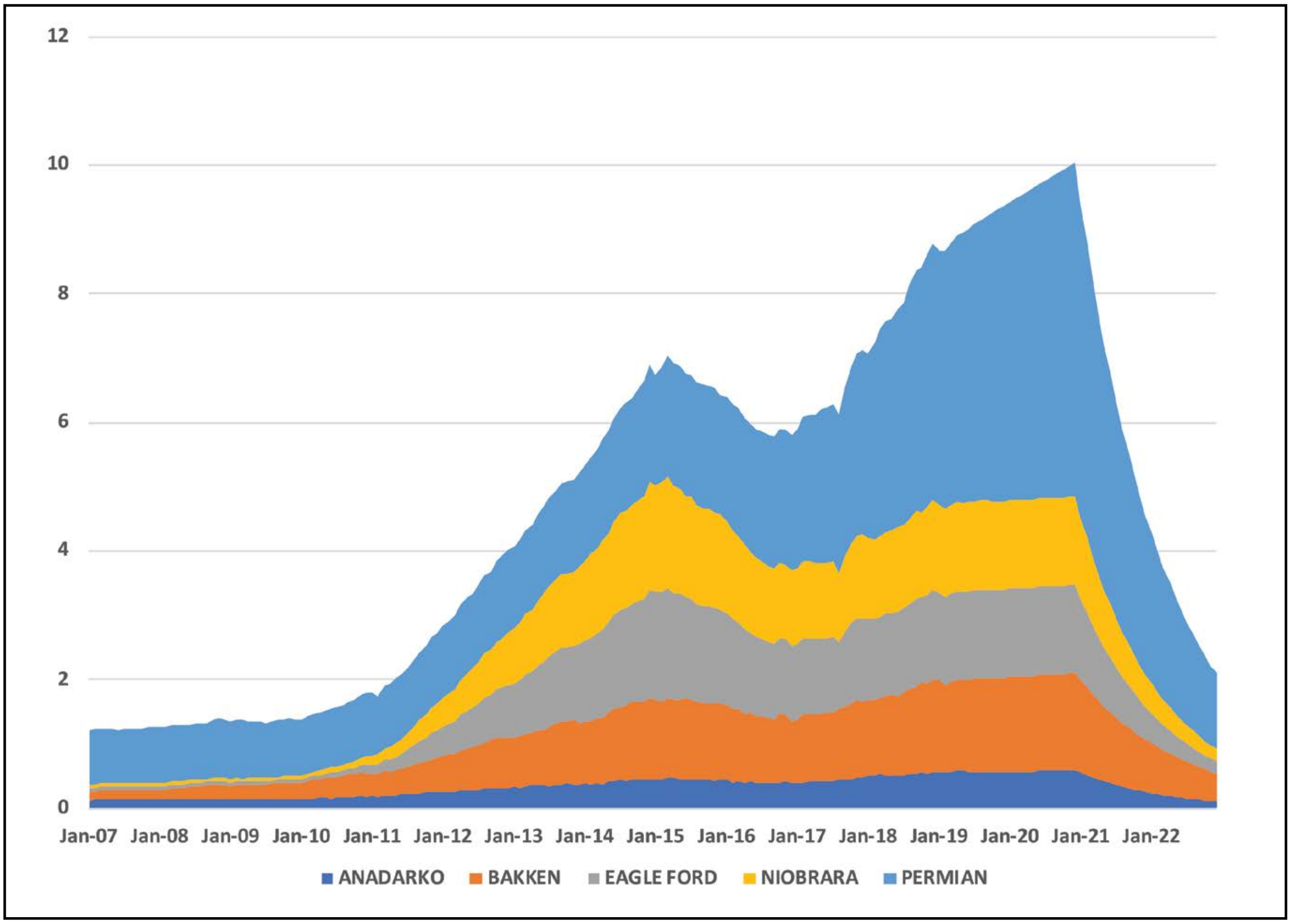
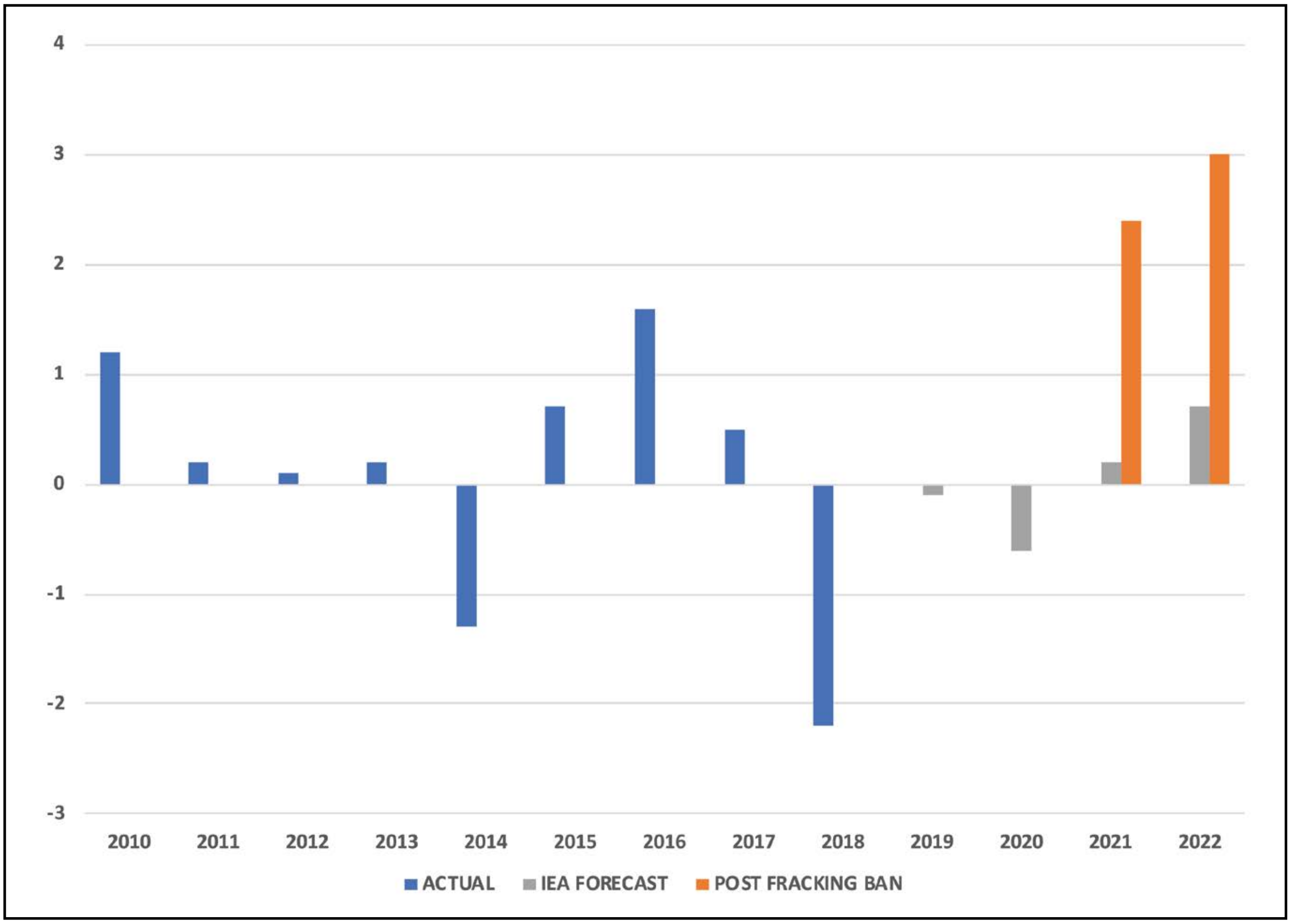


Figure ES-2
Shale Oil Production After a Fracking Ban (mb/d)



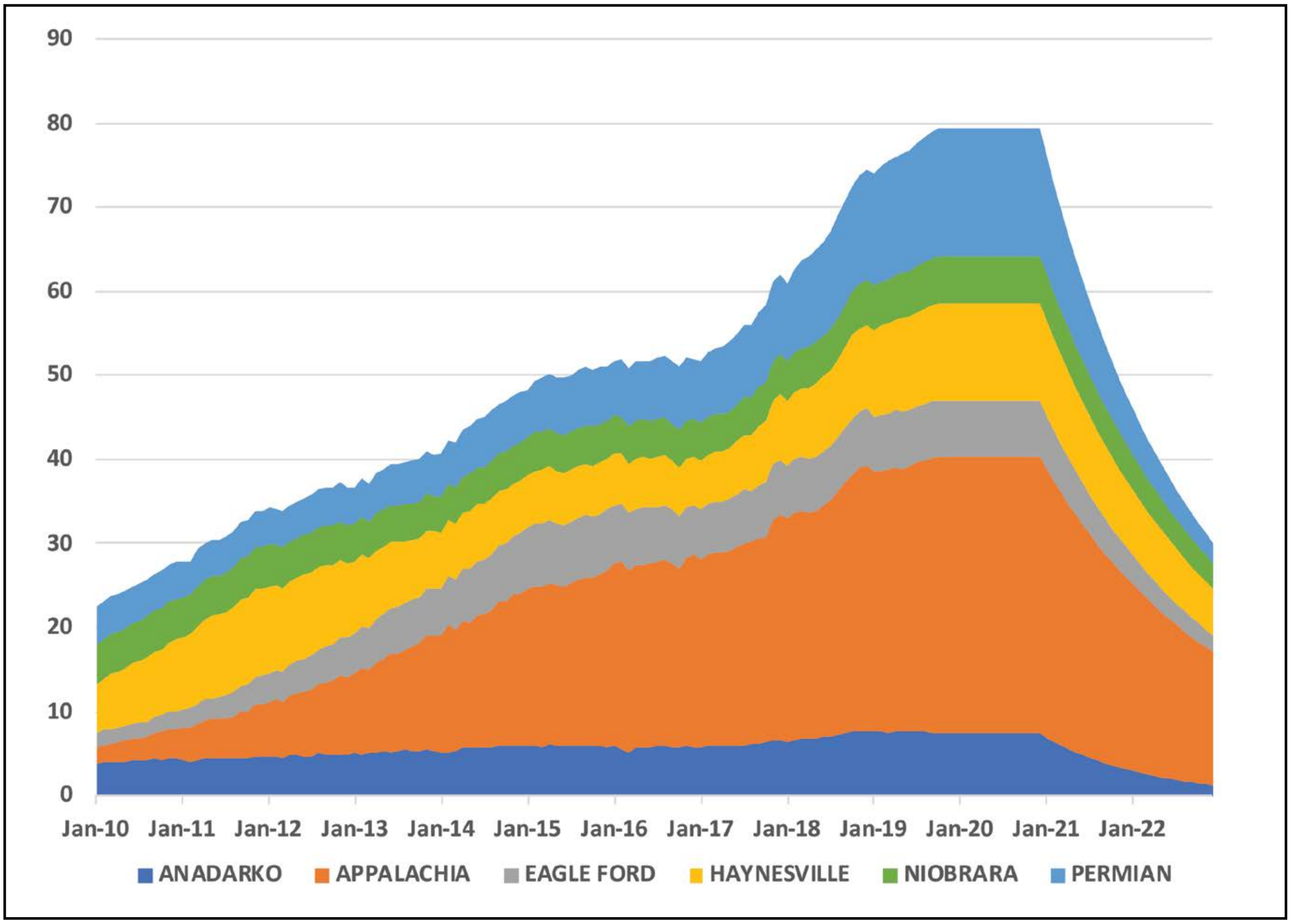
Of course, world oil prices would certainly rise as there is not sufficient global capacity to replace the lost supply. At present, only 3 mb/d of surplus capacity exists, almost all of which is in Saudi Arabia. Figure ES-3 shows how the call on OPEC would grow rapidly, beyond the ability of anyone to compensate. It is not out of the question for oil prices to rise beyond $100/barrel in such a situation.

Figure ES-3
Additional Call on OPEC with a Fracking Ban (mb/d)



Domestic natural gas output would not be as severely curtailed, partly because some of the loss can be offset by increasing conventional gas supply. In the near term, substantial price risks would remain as it would be difficult to expand imports given limited LNG import capacity. To attract imports, domestic U.S. prices would probably triple; the gas bill for consumers would grow by over $100 billion. Figure ES-4 shows the trend in shale production in the two years after a fracking ban.

Figure ES-4
Shale Gas Production After a Fracking Ban (Mcf/d)



INTRODUCTION

Hydraulic fracturing is a long-standing practice to promote well stimulation and improve extraction rates for the production of oil and gas. It has been in practice in the U.S. since the 1950's. The process involves the high-pressure injection of 'fracking fluid' (primarily water, containing sand or other proppants suspended with the aid of thickening agents) into a wellbore to create cracks in the deep-rock formations through which natural gas, petroleum, and brine will flow more freely. Although it was originally employed in conventional oil and gas production using vertical wells, its introduction as a technology to gain access to oil and gas in so-called "source rock" (using horizontal drilling) has been the primary breakthrough technology that has allowed the U.S. to become the largest oil and gas producer in the world.

The process remains controversial over concerns that it poses risks to water supplies and has been accompanied by an increase in methane emissions, which are presumably contributing to climate change. Two U.S. states, New York and Maryland, along with some foreign countries, have banned the technology. EPA has determined the process is safe and does not threaten water supplies in the U.S. At the same time, oil and gas production resulting from this process have soared, transforming U.S. and global energy markets while generating substantial economic and security benefits for the United States.

Concerns that the North American oil and gas production renaissance will make the transition to an energy future free of fossil fuels more difficult has brought about calls from several candidates for President of the U.S. to call for a full ban on the use of the process. Political candidates often seek simple remedies for complex problems and in the end it may not be easy to engage a full ban of hydraulic fracturing given current legal, political, and economic conditions. Most U.S. production occurs on private lands and would be subject to a broad range of legal protections from arbitrary and capricious policies. However, substantial production of oil and gas occurs on public lands and Presidential authority could clearly curtail future access to oil and gas resources on those lands.

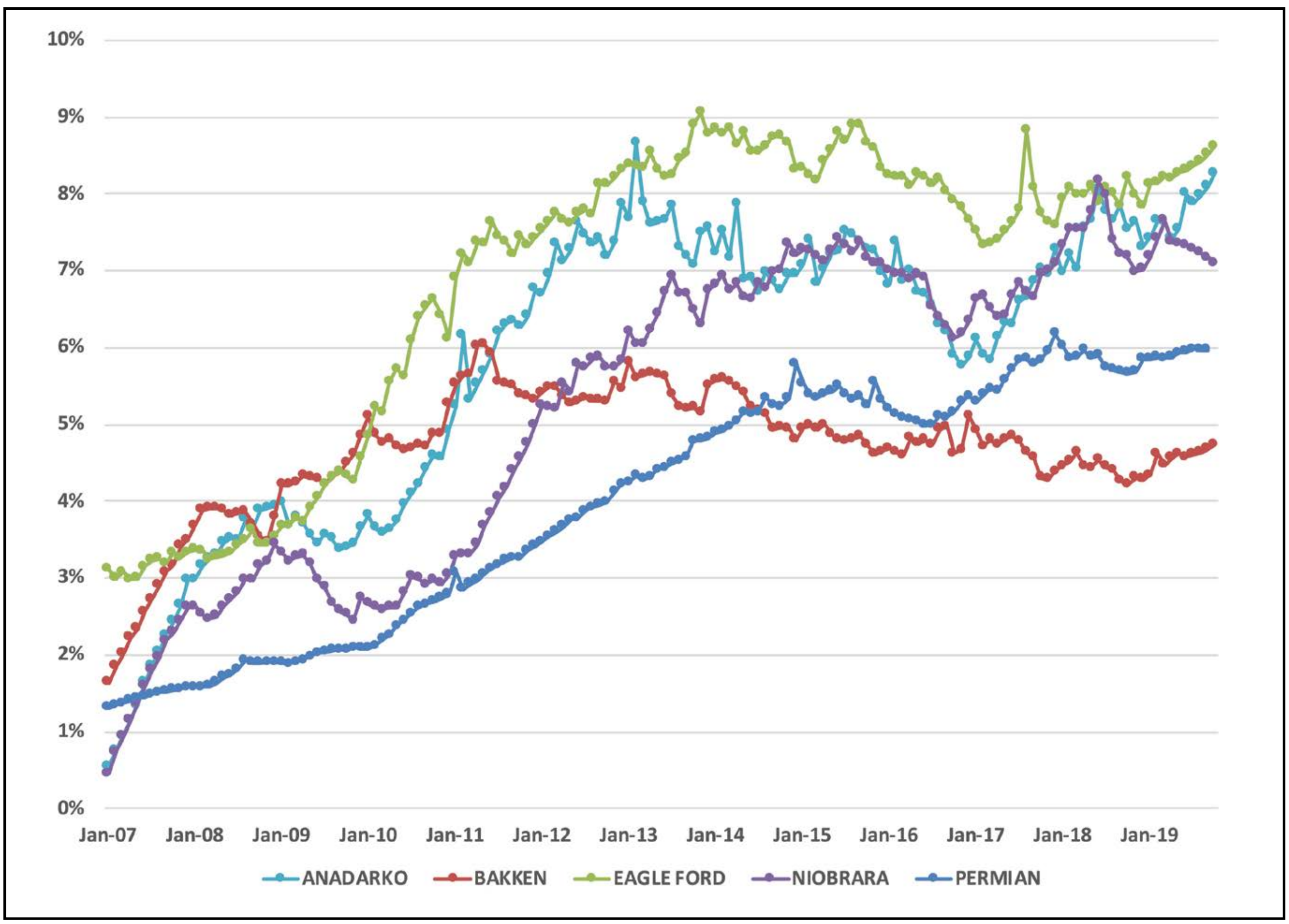
A full ban on the technology is a somewhat new development in American politics given that Democrats from President Barack Obama to California Governor Jerry Brown have not opposed (but regulated) fracking. Putting aside for the moment the climate, health and safety merits of a full ban on hydraulic fracturing, or even the likelihood such an initiative could be fully implemented, this report examines the likely consequences of such a ban on U.S. production and the resulting costs to consumers and the national economy.

Before the fracking revolution, U.S. oil and gas production had been performing poorly. Gas production grew about 10% from 1990 to 2000, but that was inadequate to meet demand, and prices, which were consistently below $3/Mcf in the 1990s, were often above $5/Mcf in the early 2000s and sometimes above double-digit prices, before shale gas reached its prime. Oil production dropped 20% from 1995 to 2005, nearly 1.5 mb/d even as global oil prices soared. (Shale oil production only topped 1 mb/d in 2011.)

What politicians appear to be overlooking is not just that shale oil and gas are the majority of U.S. petroleum production, but the wells decline much more rapidly than for conventional oil. Conventional wells tend to decline by 6-10% per year, whereas shale oil wells decline by 5-8% *per month*. The rapid decline in production from fracked wells is a prominent factor of shale oil and gas production, although it is not necessarily a bad thing as it allows producers to recover their costs quickly.[1] But it does mean that, without continuous drilling, production from a basin will drop much more sharply than from a conventional oil field.

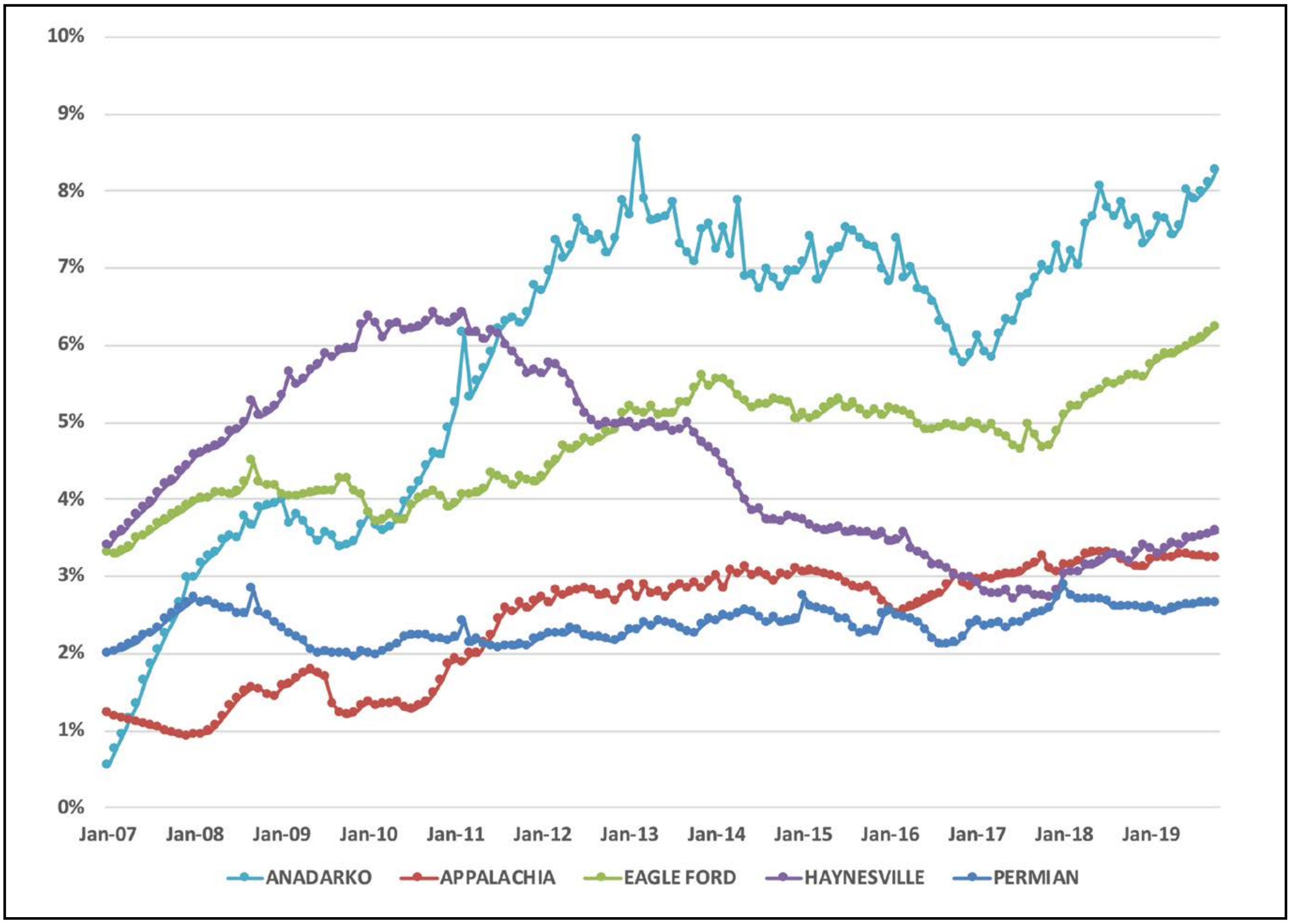
The Energy Information Administration reports regular data in its *Drilling Productivity Report* that estimates the decline each month from older wells and these are reproduced for oil and gas in Figures 1 and 2 respectively, as a percentage of total production in the basin. There is variance across regions, presumably reflecting primarily geological differences, but in each case the rate of decline is significant.

Figure 1
Decline Rate for Shale Oil Basins



Data from *Drilling Productivity Report*, Energy Information Administration, September 2019.

Figure 2
Decline Rate for Shale Gas Basins

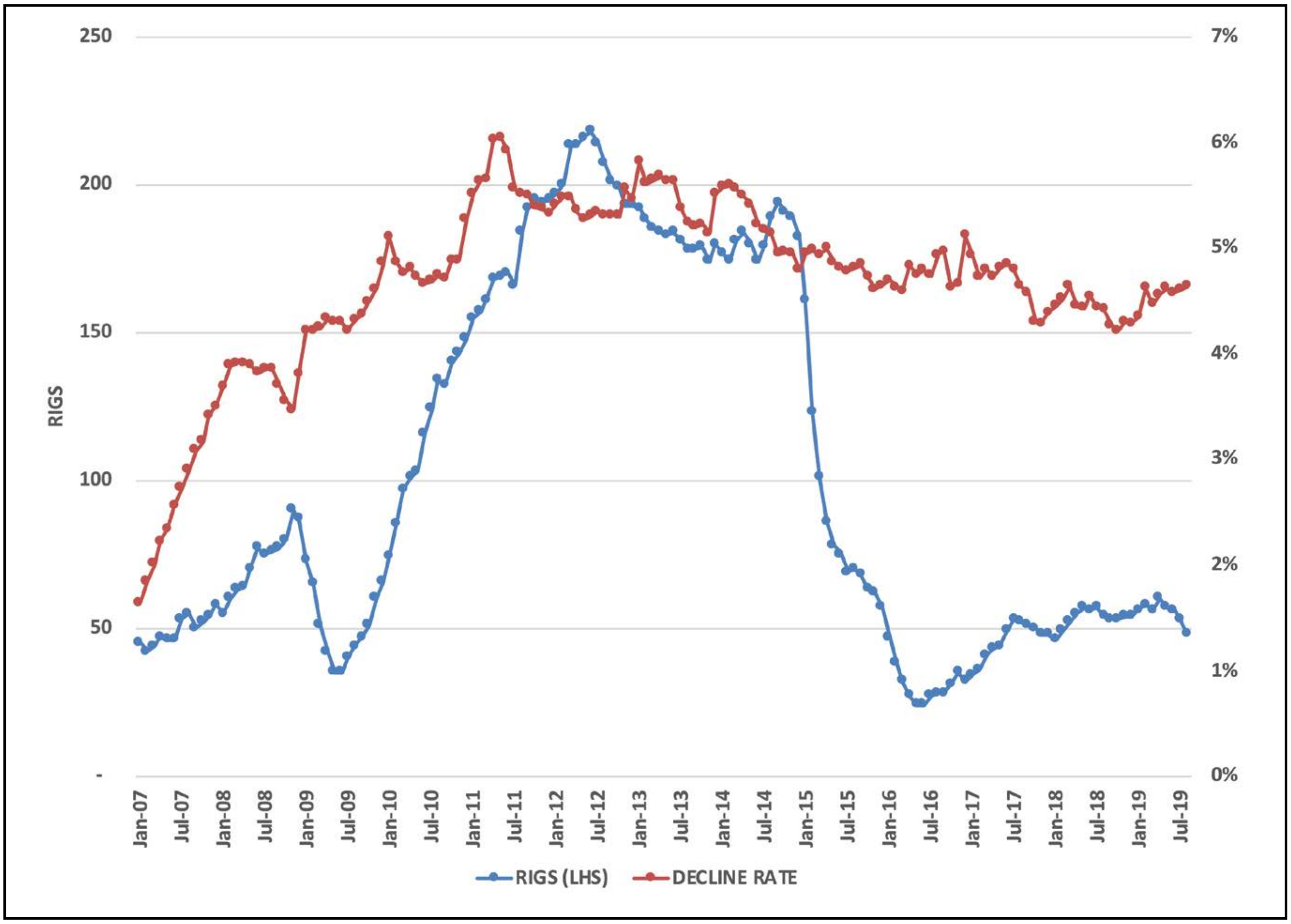


Data from *Drilling Productivity Report*, Energy Information Administration, September 2019.

It might be argued that an end to fracking would mean that aggregate decline rates would fall and the production decline be moderated as production in a basin would increasingly be dominated by older wells with lower decline rates. Without access to per-well data for each basin, the effect cannot be estimated precisely, but by examining what happened when drilling dropped in the past, some idea of the magnitude of change can be provided.

The first case is the Bakken oil shale, where the number of rigs dropped from 191 to 24 between October 2014 and June 2016. (Figure 3) During that period, the decline rate dropped from 5.0% to 4.8%, a negligible change.

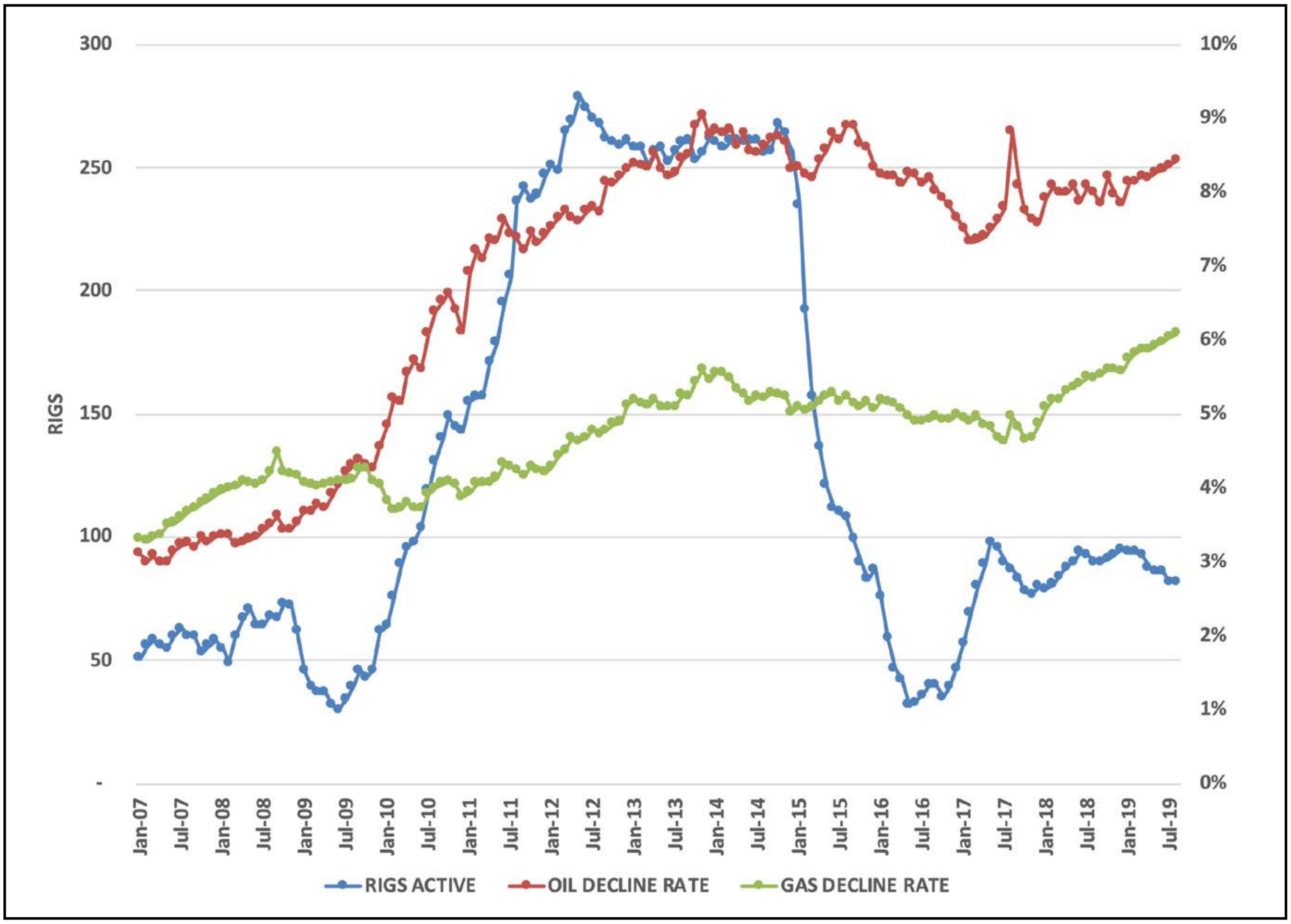
Figure 3
Bakken Decline Rate After Drilling Decline



Data from *Drilling Productivity Report*, Energy Information Administration, September 2019.

The Eagle Ford basin is not as much of a clear-cut case as the Bakken, because parts of it are gas-rich, parts liquid-rich, and the number of rigs and wells are not broken down by oil and gas by the DOE data. However, as Figure 4 shows, the sharp decline in drilling from October 2014 to May 2016—82%--had little appreciable effect on the decline rate for either oil or gas.

Figure 4
Eagle Ford Decline Rate After Drilling Decline



Data from *Drilling Productivity Report*, Energy Information Administration, September 2019.

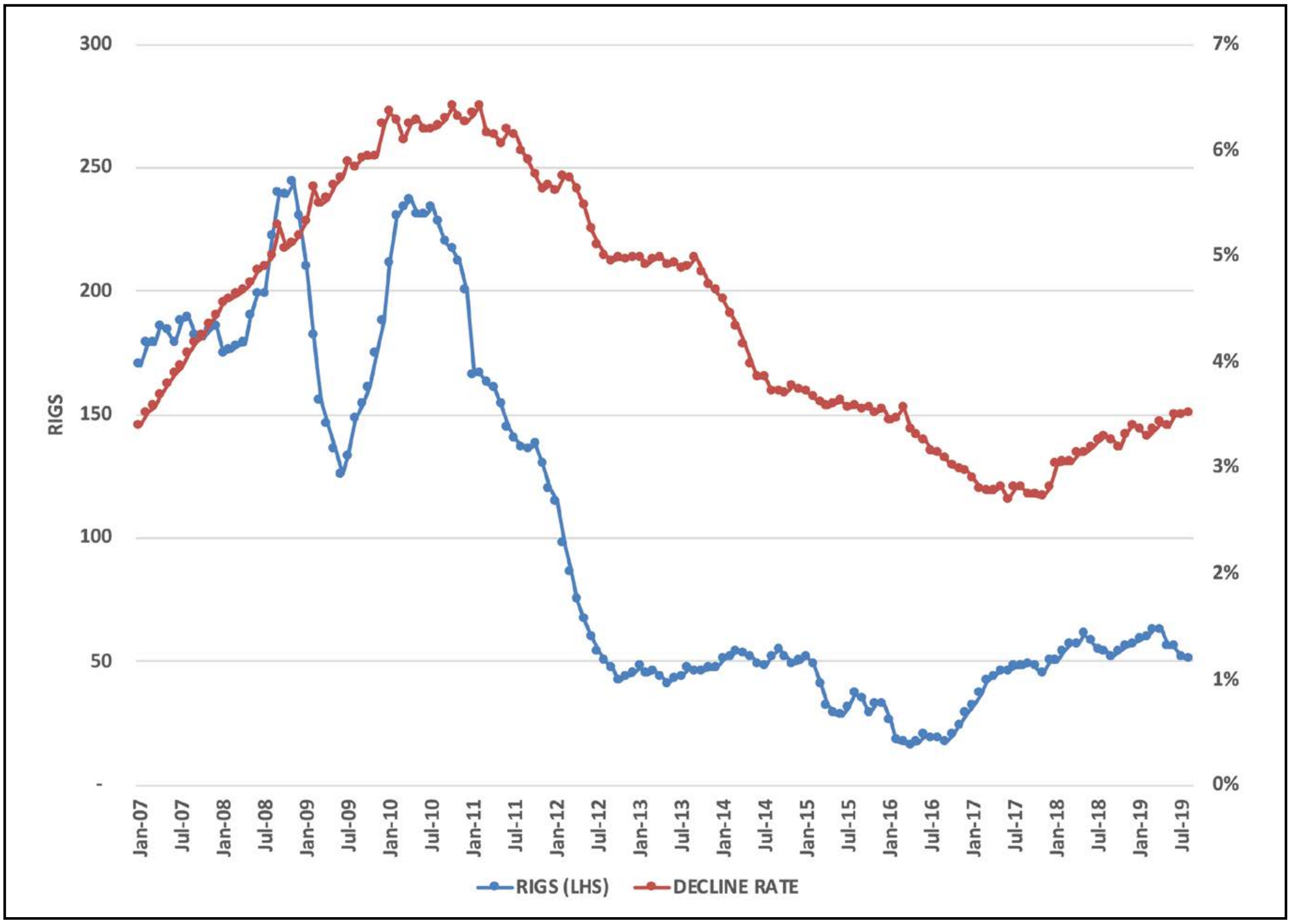
However, Baker-Hughes provides weekly rig utilization data by basin and split between oil and gas, which is presented below for the Eagle Ford (Figure 5). The collapse of gas drilling in 2012 results in only a marginal increase in the reported decline rate, from 4.9 to 5.4% over about two years. Oil drilling drops later, in early 2015, but just as severely (about 90%), however, the decline rate rises from 8.2% to 8.7%, then drops to 7.3% after 2 years.

Figure 5
Rigs Active in the Eagle Ford Basin

Source: Baker Hughes.[2]

The final case is the Haynesville, a gas basin, where drilling dropped by 80% and production fell by 40% before recovering, probably the most extreme change for any major shale basin. As Figure 6 shows, the decline rate did drop, but very slowly: after two years, it fell from 6% per month to 5% per month, although settling at 3% five years after drilling fell. This does suggest that decline rates can moderate as fewer new wells come on-line, but only with a significant lag.

Figure 6
Haynesville Decline Rate After Drilling Decline



Data from *Drilling Productivity Report*, Energy Information Administration, September 2019.

It is entirely possible that the relatively stable decline rates during periods of sharply decreased drilling reflects some aspect of the data collection and publication process, for example, the use of a smoothing algorithm. Even so, it seems reasonably safe to accept that a termination of all fracking will not see a significant reduction in the decline rate over the course of only 24 months.

POST-BAN PRODUCTION TRENDS

Applying the observed decline rates to shale oil (Figure 7) and shale gas (Figure 8) yields a rather dramatic picture of the impact on oil and gas production in the United States after a fracking ban. For the calculations, it was assumed the ban began January 1, 2021 and that 2020 production followed the EIA's forecast in the Short-Term Energy Outlook.

Figure 7
Shale Oil Production After a Fracking Ban (mb/d)

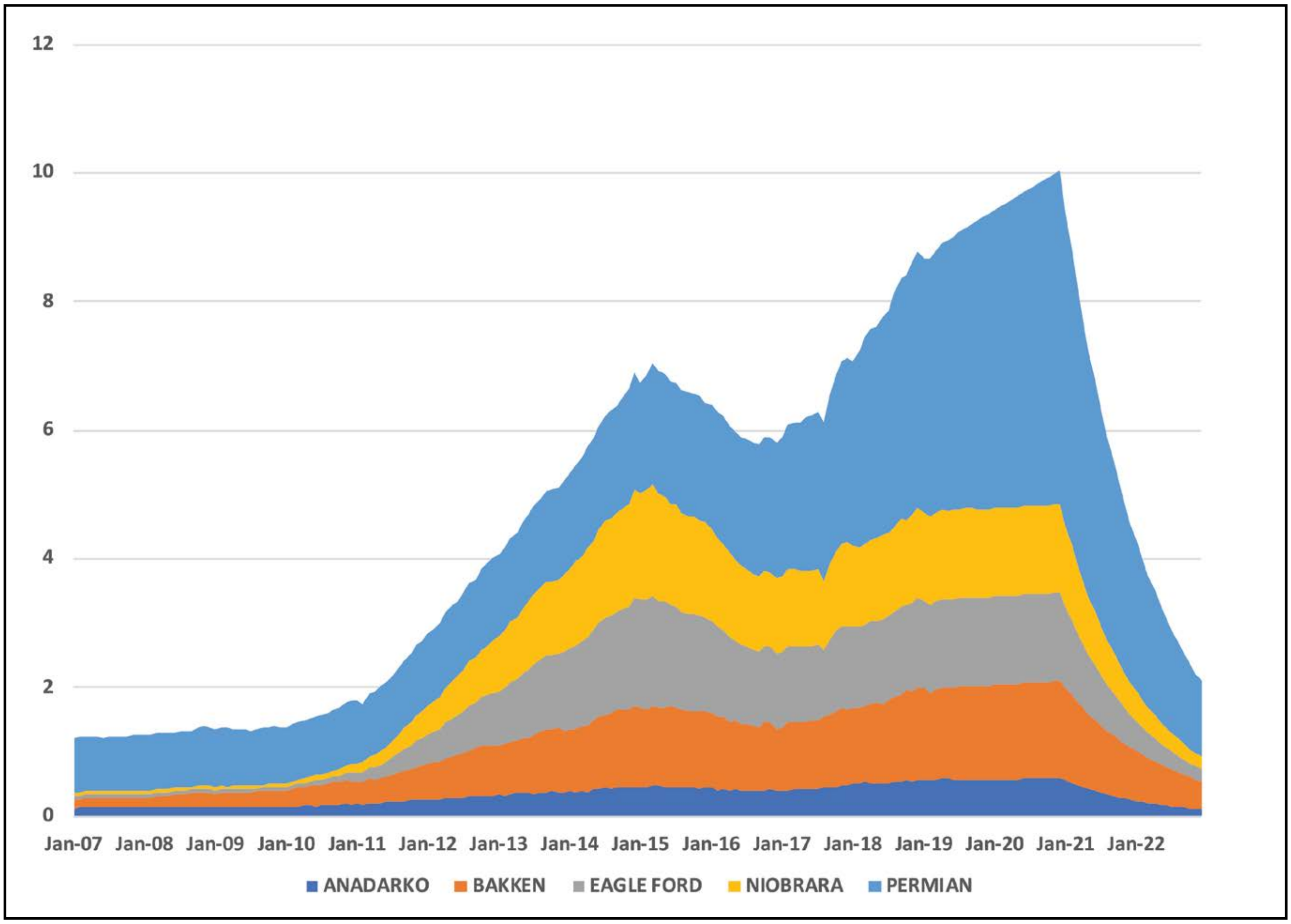
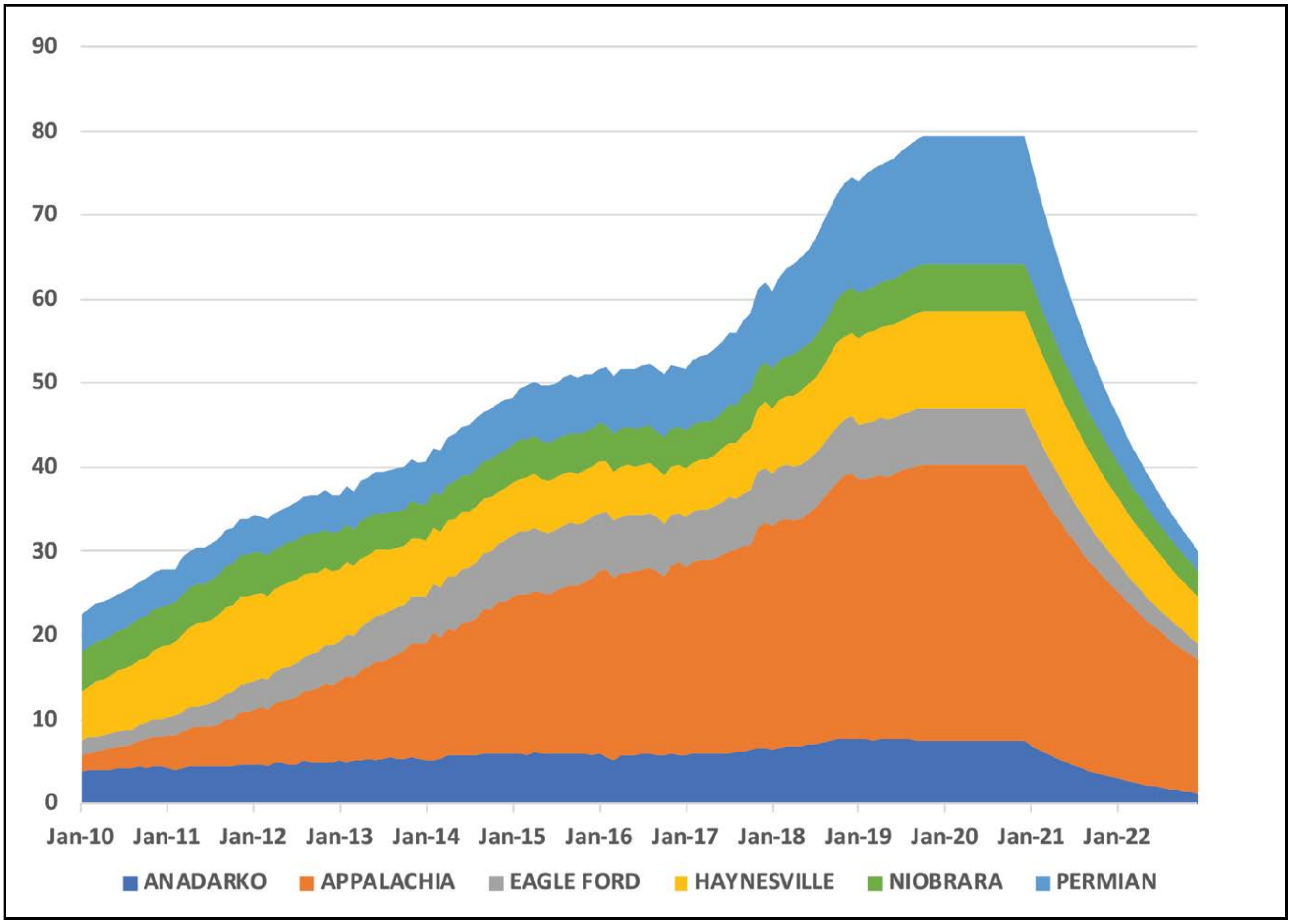


Figure 8
Shale Gas Production After a Fracking Ban (bcf/d)



Data from *Drilling Productivity Report*, Energy Information Administration, September 2019. Projection by the author.

Table 1 shows the projected trend for shale oil and gas, assuming a fracking ban takes effect on January 1, 2021, including yearly averages and year-end and -beginning figures. These assume a complete cessation of fracking, that is, no wells or leases are grandfathered in, and the impact on production is clearly severe. The 2020 numbers are roughly those projected by the EIA in its *Short-Term Energy Outlook* October 2019. NGL estimates are somewhat less precise; Appendix A describes how they were made.

Table 1
Impact of a Fracking Ban on Production

	Shale Oil mb/d	Shale Gas bcf/d	NGLs mb/d
Jan-21	9	75.9	
Jan-22	4.2	45.8	
Dec-22	2.1	30.1	
2019	8.4	77.2	5.6
2020	9.2	79.4	6.2
2021	6.5	60.6	4.7
2022	3	37.3	2.9

Data and 2020 figures from EIA. Forecast from the author.

It only stands to reason that if fracking is banished, the industry will shift some of its resources to developing new, conventional oil and gas production. (A ban on offshore drilling might see investment funds move onshore, but obviously equipment would not.) An estimate of how much can be expected is made in this section.

The first step is to understand what conventional drilling was like in the days before the shale revolution. In Table 2, the average number of rigs active and wells drilled from 1995-2000 is shown, along with the capacity additions for oil and gas during that period. (The calculation of capacity additions is described in Appendix A.) Obviously, the capacity additions over the six-year period are well below what has been seen in the shale basins in recent years.

Also, recent development has emphasized oil wells over gas wells, partly because gas wells in the Marcellus are much more productive and natural gas production is constrained by consumption plus exports: surplus oil can always be exported in theory, although the cost is sometimes high.[3] Thus, it is possible, even logical, that some current oil rigs would target conventional natural gas instead of conventional oil.

In Table 2, the impact of the rebound in conventional drilling after a fracking ban is shown under two assumptions. The number of rigs operating will be the same as in 2018, just repurposed from shale, and in the first case, the oil/gas ratio of drilling rigs remains the same. In the second case, it is assumed natural gas drilling is emphasized, with roughly the same total rigs active. No adjustment is made for any difference in quality in the rigs in the 1995-2000 period versus the present.

Table 2
Impact of Shifting Drilling to Conventional Petroleum

Actual 1995-2000	Oil tb/d	Natural Gas bcf/d
Avg Rigs Active	265	531
Development Wells Drilled	52,000	75,000
Wells/Rig Year	33	24
Capacity Additions	3,050	39
Cap/well	59	0.52
2018 Rigs Active	841	190
Potential Wells	27,504	4,473
Capacity	1,613	2.32
Assuming Gas Emphasis		
Rigs Active	265	800
Potential Wells	8,667	18,832
Capacity	508	10

Data and 2020 figures from EIA. Forecast from the author.

Using the estimates in Table 1 for lower shale drilling and those in Table 2 for a rebound in conventional drilling, gives the modified production estimates in Table 3.

Table 3
Production After Fracking Ban and Rebound in Conventional Drilling
Production shown is shale plus the amount of additional conventional production.

	Shale Oil mb/d	Shale Gas bcf/d	NGLs mb/d
Jan-21	9	75.9	
Jan-22	4.2	45.8	
Dec-22	2.1	30.1	
2019	8.4	77.2	5.6
2020	9.2	79.4	6.2
2021	6.5	60.6	4.7
2022	3	37.3	2.9
Assuming Switch to Conventional Drilling			
2021	7.6	67.1	5.2
2022	6	43.8	3.4
With Gas Emphasis			
2021	7	70.6	5.5
2022	4	47.3	3.7

In all likelihood, the scenario where natural gas drilling rises is much more likely than that the number of oil rigs operating remains constant after a fracking ban, since the conventional oil resource is much more mature than the gas resource. The higher level of oil drilling in 2018 reflects the richness of the Permian and other shale oil basins, and operators will not have conventional targets that would encourage them to run three times the number of drilling rigs as occurred in 1995-2000. It is also possible that, instead of switching many shale oil rigs to conventional natural gas targets they will be idled, so that the production estimate here is too optimistic. However, as will be discussed below, U.S. natural gas prices are likely to rise sharply, which would encourage more gas drilling than in 2018.

IMPACT OF A FRACKING BAN

Such a sharp, indeed unprecedented decline, in oil and gas production would have major effects not only in the United States, but around the world. Oil prices would undoubtedly rise, along with international natural gas prices, boosting petroleum exporting countries' economies but doing serious damage to importers and almost certainly triggering a global recession.

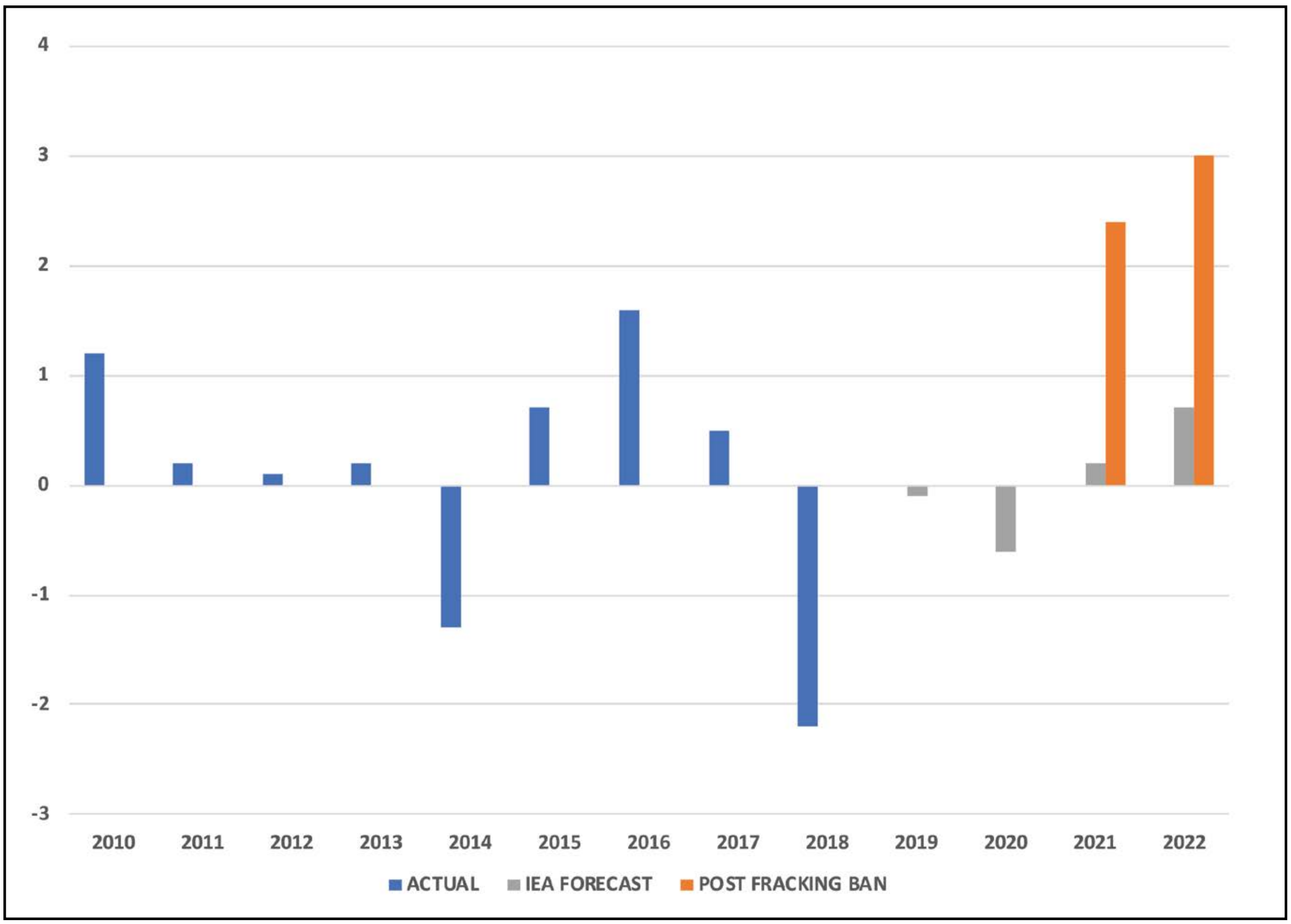
Some indirect impacts would be obvious: travel and tourism would surely suffer, prices of energy intensive materials would rise, and shipping costs for all goods would go up, with bulk goods naturally being damaged disproportionately.[4] The much higher consumer expenditure on energy would have a severely deflationary effect, and could conceivably trigger a recession.

PRICE CHANGES DUE TO FRACKING BAN

Although there are no reliable methods for producing short-term oil price forecasts with any degree of accuracy, the shift in market balances for oil and gas after a fracking ban implies significantly higher prices are certain.[5] In terms of world oil markets, the need to replace 5 to 6 mb/d of production in two years will clearly push prices higher. Figure 9 shows the current forecast for year-on-year change in demand for OPEC from the IEA, and impact of lower U.S. shale liquids production.

As of October 2019, the global spare crude oil production capacity is estimated at 2.8 mb/d, mostly in Saudi Arabia.[6] The only two countries that are likely to be able to add significant amounts of capacity in such a short period of time are Iraq and Saudi Arabia, and doing so would require an emergency investment program, which seems unlikely to be enacted. This would leave the world oil market short of at least 3 mb/d of petroleum, possibly more depending on NGL production in the United States.

Figure 9
Call on OPEC Year-on-Year (mb/d)



Sources: Actual and IEA Forecast from IEA *Oil Market Report*; other from the author.

Of course, since a fracking ban would be initiated by a Democratic president, he or she might end the sanctions against Iran that have seen its production drop by over 1.5 mb/d. For Venezuela, an end to American sanctions might allow partial recovery of the roughly 2 mb/d of lost supply. Still, both are likely to find restoring production difficult and slow and it is very doubtful they could replace the lost 3 mb/d of supply in two years.

At any rate, even in the most optimistic scenario, there would be no spare capacity in the global oil market and post-2023 declines in U.S. shale oil production would increase the pressure. As a result, it seems all but certain that prices would rise to between $80 and $100 per barrel and perhaps higher.

For natural gas, the situation is different. In recent years, the surge in U.S. LNG exports has helped to create a global glut and depressed spot prices at least to below $7/MMBtu in Asia and Europe. The shift from exporting 4 Tcf/yr to net imports of as much as 4 Tcf/yr would clearly tighten that market and bring the price for internationally traded natural gas close to parity with oil prices, in other words, over $10/MMBtu. Plus, it must be assumed that the country would pay world prices for imports, which means that domestic prices would rise sharply, from the current sub-$3/MMBtu to at least $7.5 and possibly $10/MMBtu.

ECONOMIC IMPACT OF A FRACKING BAN

The effects on a fracking ban on the wider U.S. (and global) economy would be widespread and significant, but providing detailed estimates is beyond the scope of this study. A macroeconomic model of the economy could quantify the impact in great detail, but even without it, some basic estimates can be made.

Table 4 shows how the costs of traded oil and natural gas would change for the global economy, using aggregate import data compared to actual 2018 prices (both from BP) and the possible higher prices that might result from a fracking ban. A significant amount of imported oil and gas is re-exported, meaning the gross import figure in Table 4 is overstated by perhaps as much as one-third, nevertheless, the impact is quite clear: the world, energy importing countries especially, would see a much larger bill for their oil and gas imports, by hundreds of billions of dollars. The natural gas import cost would rise from $340 billion to $400-500 billion, while the oil import bill could be $200 to $700 billion higher.

Table 4
Global Petroleum Trade: Impact of a U.S. Fracking Ban

	2018 Imports mb/d	2018 Price $71.06/bbl	Cost (trillion$)	
			$80.00/bbl	$100.00/bbl
Petroleum	70	$1.82 trillion	$2.04	$2.56
Natural Gas Pipeline	28.42 Tcf	$6.62/Mcf	$8.00/Mcf	$10.00/Mcf
LNG	15.21 Tcf	$10.00/Mcf	$12.00/Mcf	$15.00/Mcf
Revenue ($billions)		$340.26	$409.90	$512.38

Pipeline price is German import price; LNG is Japan cif price. Both from BP Oil price is Brent for 2018. (DOE)
Data from EIA. Forecast from the author.

The most clear-cut is the damage to the U.S. trade balance, where the country will move from nearly net zero energy imports to very high levels of expenditures for both oil and gas. Table 5 shows the change in the U.S. trade deficit for petroleum at different prices as shale oil production declines, including assumed prices of $50, $60 and $80/bbl. In the most extreme case, with no additional conventional oil drilling and an import price of $80/bbl., the U.S. import bill would increase by $200 billion in 2022. In future years, the amount would grow. As discussed above, increased conventional drilling would probably only mean a difference of 1 mb/d by 2022, or 15%.

Table 5
U.S. Oil Trade Balance After Fracking Ban

	U.S. Oil Balance					
	Shale	Total		Trade Deficit at Price:		
	Production	Liquids	Imports	$50	$60	$80
2019	8.4	19.67	0.87	($15.88)	($19.05)	($25.40)
2020f	9.2	21.25	-0.49	$8.94	($10.73)	($14.31)
2021	7		1.71	($31.21)	($37.45)	($49.93)
2022	4		4.71	($85.96)	($103.15)	($137.53)

Data from EIA. Forecast from the author.

The economic impact of a fracking ban on the country's natural gas trade is a more complex calculation, since it involves first, a loss of export revenue, followed by higher pipeline imports from Canada, and then LNG imports at much higher prices. In Table 6, the basic numbers are shown assuming lost exports are at 2018 prices (section B), while higher imports are first assumed with 1 Tcf/yr from Canada at 2018 prices of $2.68, all others at $8/Mcf (section C); and section D assumes all imports must be at $8/Mcf.

Table 6
Natural Gas Trade Deficit After Fracking Ban ($billions)

	A) Production Drop		B) Lost Export Revenue		C) Higher Imports		D) Higher Import Prices	
Production Change Tcf/Yr	2021	2022	2021	2022	2021	2022	2021	2022
Basic ban	6.9	8.5	$15.6	$15.6	$2.1	$25.9	$6.4	$19.2
Ban with shift to conventional drilling	4.5	8.5	$15.6	$15.6	$1.3	$30.7	$4.0	$36.0
Ban with emphasis on conventional gas	3.2	4.8	$1.7	$4.2	$0.0	$2.1	$0.0	$6.4

C) is assuming pipeline imports remain at $2.68. LNG imports at $8 D) is assuming all imports are at $8.
Data from EIA. Forecast from the author.

A massive shift to conventional gas drilling could mean that, while the U.S. loses billions in export revenue, it would not have to import additional natural gas, at least for the first two years. However, if gas drilling were at the average rate of 1995-2000, then the U.S. would be importing more gas by the end of 2022. (The assumption of drilling with an emphasis on gas would mean 50% more rigs focused on gas than in 1995-2000, which is possible but doubtful.)

The price assumptions here are quite modest. Especially if the U.S. must import LNG, domestic prices would certainly rise. And if world oil prices rise, as discussed above, U.S. import prices will be higher and domestic prices would rise accordingly.

Consumer expenditures on oil and gas are another matter. While it is true that higher prices for domestic production do not do the same degree of damage to the domestic economy as higher prices for imports, nonetheless it represents a transfer of wealth from consumers to producers. Much of it is recycled, but not efficiently. Table 7 shows the additional amounts that would be spent on oil and gas given different assumptions about price increases.

Table 7
U.S. Energy Expenditures Due to Higher Oil and Gas Prices

	Increased Expenditure ($billions)			
	Petroleum w/ price increase of:		Natural Gas w/ price increase of:	
	$10/bbl	$30/bbl	2/MMBtu	$4/MMBtu
2021	$76.7	$230.0	$62.1	$124.1
2022	$78.5	$235.4	$63.0	$126.0

Estimates by the author.

Again, some of that revenue would flow into the hands of domestic producers, but the implication is that the U.S. consumers would see a bill equal to about twice the size of the Trump tax cut. The deflationary impact would be significant.

Geographically, it seems obvious that areas with shales under production would be hit first, including Ohio, Pennsylvania, Colorado, North Dakota, Texas, Oklahoma and New Mexico. States in the Southwest might not lose too many jobs, as drilling switches to conventional resources, but that is less true for the Appalachian shales. For instance, there are approximately 200,000 oil industry workers in Ohio and Pennsylvania[7], and a fracking ban would mean that most of those jobs would be lost, even if workers moved to conventional drilling, which would tend to take place in other states.

And producing states like Pennsylvania also receive tax payments that would ease and/or stop with a fracking ban. Pennsylvania receives $250 million in 'impact' payments,[8] whereas Texas, in fiscal 2019, received just under $4 billion in oil production taxes.[9] Again, higher prices and a switch to conventional production might increase revenue in Southwestern states, but others would see major and sudden losses.

On the consumer side, not only will the national economy be affected by higher prices, but some individual states will be hit harder than others. Table 8 shows the top five U.S. states in each category, their energy consumption per capita and per GDP.

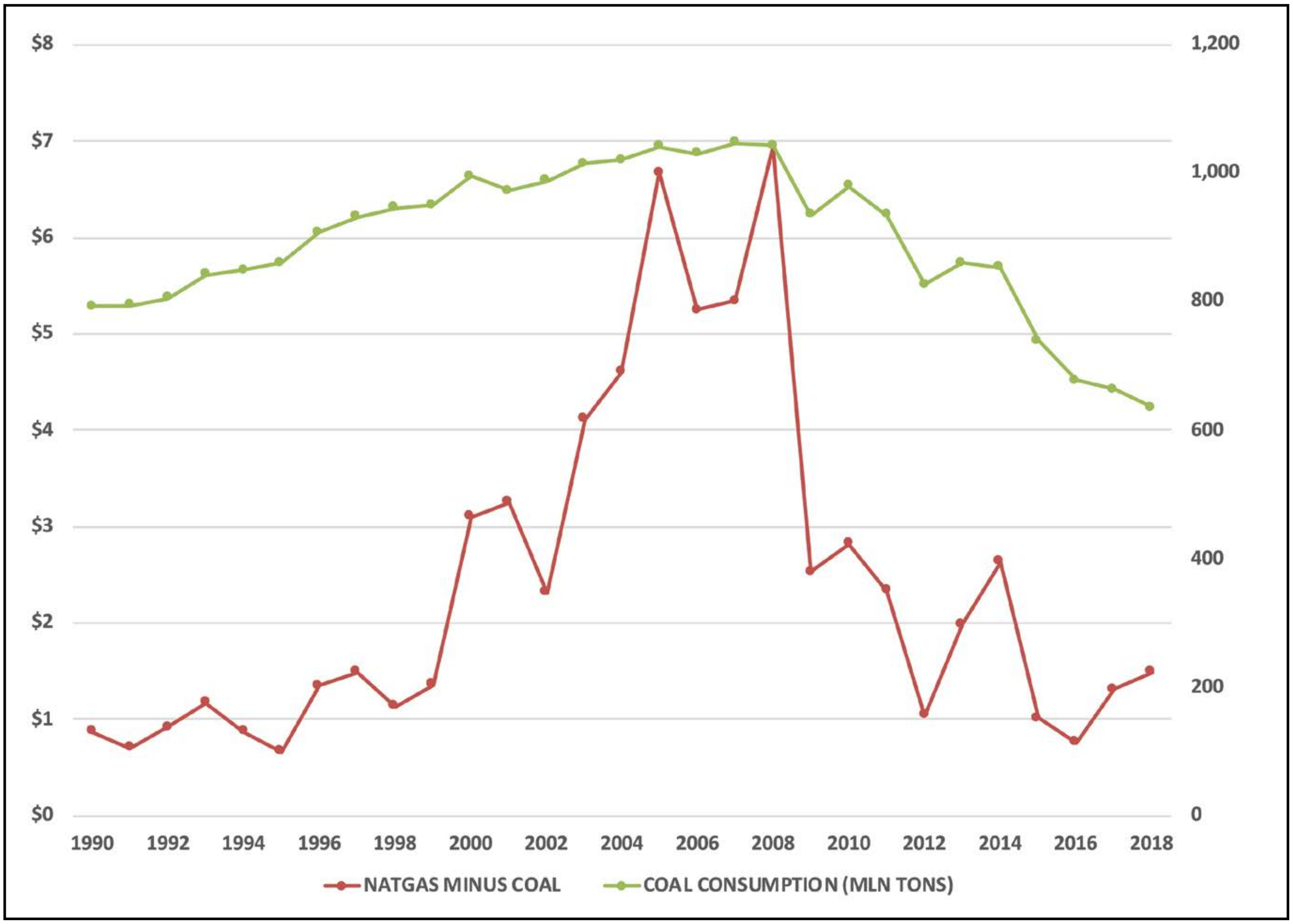
Table 8
States Most Vulnerable to Higher Oil and Gas Prices

Natural Gas		Petroleum					
MMBtu/capita		MMBtu/mln$ GDP		MMBtu/capita		MMBtu/mln$ GDP	
Alaska	466.3	Louisiana	6675.4	Indiana	429.9	Iowa	7785
Louisiana	368.6	Alaska	6283.1	Alaska	304.0	Missouri	4304
Wyoming	231.9	Mississippi	4734.7	Dist. of Col.	273.3	Mississippi	4096
Mississippi	182.1	Wyoming	3425.5	Wisconsin	244.6	Dist. of Col.	4037
Oklahoma	175.4	Oklahoma	3414.9	Oregon	226.9	Colorado	3613

A RESURGENCE OF COAL USE?

One of the ancillary benefits of the shale revolution has been the reduction in the usage of coal for power generation, as it has been displaced by cheap natural gas. Figure 10 shows how coal consumption by utilities peaked in 2008, when natural gas prices were particularly high, and then began declining almost immediately as the price differential between natural gas and coal delivered to utilities fell to $3/MMBtu and has remained below that level since.

Figure 10
Coal Consumption by Utilities and Price Differential Between Gas and Coal



Source: Energy Information Administration

Given that coal prices have been below $2.50/MMBtu for years, if a fracking ban resulted in natural gas prices rising to $8/MMBtu or more, then the competitive position of gas and coal would be reversed.

STRANDED ASSETS

Some of the oil industry's investments in recent years have been specific to the fracking of shales, others are more general in nature, but due to specific issues such as location are de facto tied to the production of shale oil and/or gas. Declining shale production in various areas will mean underutilization and abandonment of some pipelines, for instance, even though they could theoretically carry conventional oil and gas production.

The most obvious impact will be on LNG export facilities, as the natural gas available for export will all but disappear. At present, there are six facilities operating with 9 bcf/d of capacity[10] and 8 bcf/d of capacity under construction.[11] Given various estimates of capacity costs, there would appear to be $25-50 billion of capital tied up in the export terminals, most of which would be lost if exports ceased, although some of the equipment could be used to supply LNG imports.

A number of major pipelines would see their utilization drop sharply with the result that much of their value would be lost. Some of the pipelines from the Marcellus and Utica shales would be abandoned and it is unlikely that the current expansion of Permian pipelines would be operational for very long. At a rough estimate, this could effect at least $5 billion in investment and perhaps five times that much.[12]

The steel industry would obviously be hit, since both drilling and pipelines require significant amounts of steel. Just as an example, the 450 mile Kinder Morgan Wink pipeline, with 145 tb/d of capacity, needs 22,300 tonnes of steel.[13] A recent news story described how the slower drilling levels of 2019 had seen significant damage to supporting industries, from which the oil and gas producers purchased $48 billion of goods in 2018.[14]

And while many rigs would continue operating, targeting conventional instead of shale resources, the fracking rigs would become largely unemployed. At present, there are an estimated 350 of these crews, which include a dozen or more trucks each.[15] Repurposing them would be difficult at the least.

In individual terms, perhaps the best illustration of what would be lost is the Shell Pennsylvania ethane cracker, which costs $6 billion and has 600 full-time jobs.[16] An associated 100 tb/d pipeline and rail capacity to ship the plastic manufactured would be lost in part; it is hard to imagine the ethane would be replaced by imports, but not inconceivable.

CONCLUSION

The production process for unconventional oil and gas wells requires sustained investments as the process is characterized by rapid decline rates. A ban on fracking (should the new administration be able to overcome a large array of legal and political obstacles) would result in large and sustained declines in U.S. oil and gas output, with oil and natural gas liquids dropping by 7 million barrels per day in two years and natural gas falling by 11 billion cubic feet per day over the same period, even with a huge rise in conventional drilling. Job losses in the U.S. petroleum and related industries would start with the layoffs of over ten thousand fracking crews and direct losses would be over 150,000 jobs, with indirect losses about three times that much. The bill in the first two years of a fracking ban could be, by conservative estimates, an extra $150 billion on the trade deficit and $300 to $600 billion in additional consumer expenditures for oil and gas.

ADDENDUM: IMPACT OF DECLINING SHALE GAS PRODUCTION ON THE POWER SECTOR

The fact that gas production would decline quickly also means significant stress on the U.S. electricity sector. Some, like Prof. Kassie Siegel of the Climate Law Institute have suggested "Clean renewable energy solutions are available." Responding to Sam Ori's comment on the difficulty of such a rapid transition, she added, "We transformed our economy far faster during World War II than you propose."[17] This strikes me as disingenuous and misleading.

In 2018, the U.S. used 12 Tcf of natural gas to generate 1469 billion kilowatt hours of electricity. As shown in Table 3, an optimistic view of production would be a decline of 3.9 Tcf from 2020 to 2022, this would most likely hit the power sector most. The implication is of a loss of about 480 billion kwhs. Given that in 2018, electricity from solar was 63.8 billion kwhs, solar power capacity would have to be increased by a factor of seven in two years. Solar and wind together generated 336 billion kwhs, so an increase in capacity in two years of 40% would be needed.

However, the annual increases in production for wind and solar have been running about 45 billion kwhs in the past few years, meaning that production would have to increase five times faster than the best years to date. The likelihood that this could be accomplished is negligible, given the time lags for siting, permitting and construction, and the bottleneck that lack of skilled workers will cause. But it could easily require $100 billion a year of investment just for the new capacity.

Further, it would mean substituting new construction for existing capacity, essentially throwing away about 50-100 GW of gas capacity, which would cause massive financial losses for the utility industry. Further, even if solar and wind could replace the abandoned gas power, their reliance on gas turbines for backup could mean that expensive batteries would be needed.

APPENDIX A

Basis of Calculations

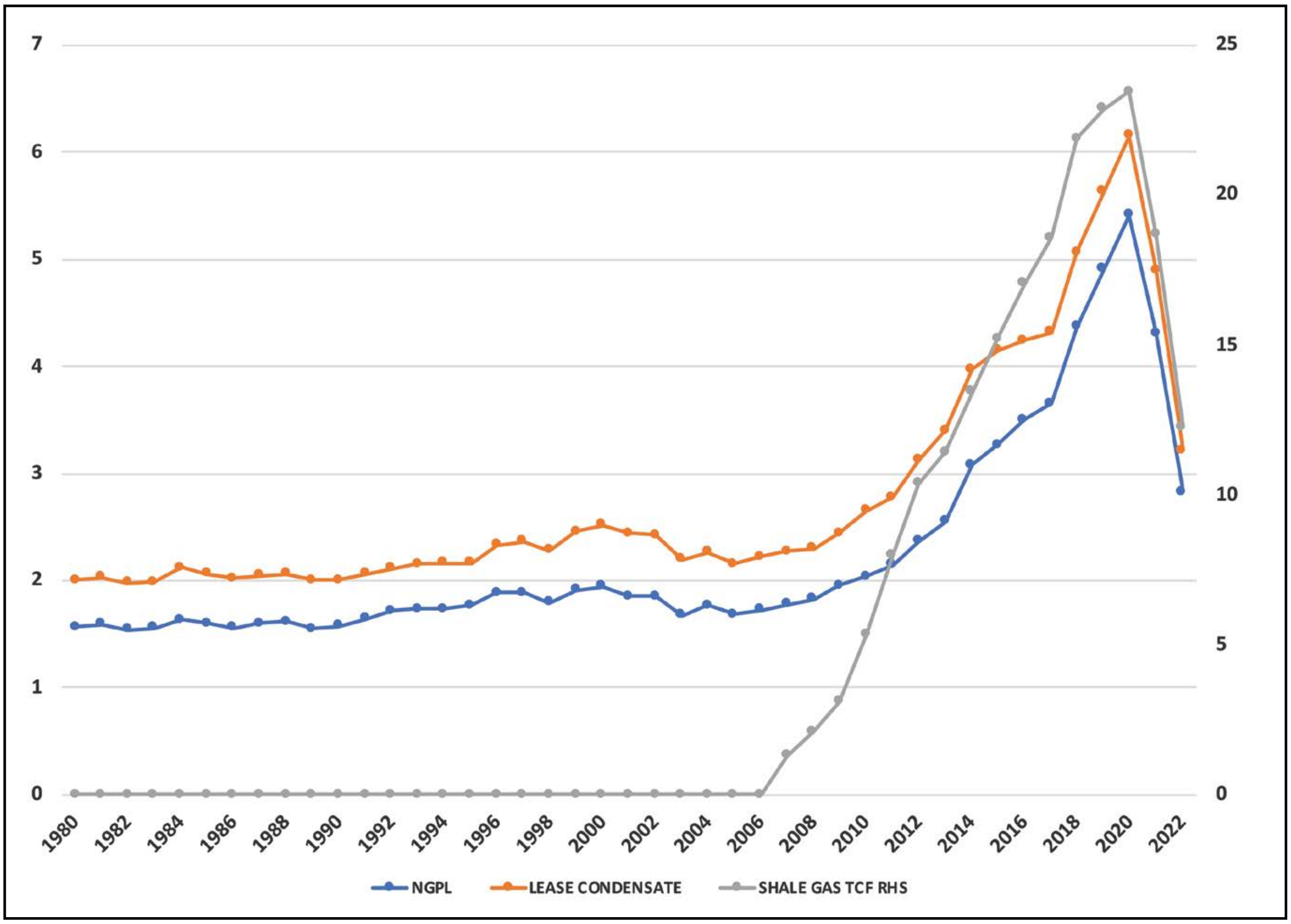
In all economic analysis of this sort, there is a degree of uncertainty and almost any given calculation will have at least a five to ten percent likely error. By providing this appendix, the reader can assess the data used, the calculations made, and the assumptions employed, where necessary.

While a spreadsheet can generate answers to many decimal places, that is a false precision. The results in this report are, however, significant enough that the margin of error is basically irrelevant.

NGLs

Natural gas plant liquids and lease condensate production data is not reported to the same degree of detail that shale oil and gas are, however, as Figure A-1 shows, they are both closely related to shale gas production. Lease condensate is from both associated and non-associated natural gas, so is partly related to shale oil production, however, shale gas production statistics include the associated gas from shale oil production, so that the correlation remains valid.

Figure A-1
Natural Gas Liquids Production and the Impact of a Fracking Ban (mb/d)



Data and 2020 figures from EIA. Forecast from the author.

Conventional Oil & Gas Rebound

The number of wells drilled from 1995-2000 is taken from the EIA database.. Development wells only are used (exploratory wells make up less than 10% of the total and do not necessarily add to productive capacity) and dry holes are allocated to oil and gas drilling proportionately.

The rig numbers are from the same source, and no correction is made for onshore and offshore as the data does not permit it. Since offshore rigs are typically about 10% of the total, any resulting error will be small.

Capacity added is calculated using the equations derived by M. A. Adelman (1993). It is assumed that production in the United States equals capacity. After the Texas Railroad Commission ended its practice of setting production quotas in 1972, producers have typically produced at full capacity except when performing maintenance. Net capacity additions is thus the change in production from year to year (sometimes negative). Gross capacity additions includes the replacement of capacity lost to depletion. The depletion rate as calculated by Adelman is the percentage equal to the production in a year divided by the average of the proved reserves number at the end of the previous and current years.

Price Impact

As I have described at length elsewhere, there is no valid pricing model for world oil markets, since the many political variables affecting demand and especially oil supply make it impossible to provide a specific oil price response to a given decline in oil supply from any particular source, in this case, shale oil.

For natural gas prices, if the U.S. is going to import large-scale amounts of LNG, the import price has to be equal to world price for LNG. Unfortunately, there is not yet a mature market for LNG where price is set by supply and demand; in Asia, for example, 75% of LNG sales are linked to the price of oil, while 65% is so linked in Europe.[18]

ENDNOTES

[1]Environmental Protection Agency, "Hydraulic Fracturing For Oil And Gas: Impacts From The Hydraulic Fracturing Water Cycle On Drinking Water Resources In The United States," December 2016
[2]https://bakerhughesrigcount.gcs-web.com/rig-count-overview
[3]The September 2019 Drilling Productivity Report from the EIA puts production per rig in Appalachia at 18 mcf/d, or about 3 tb/doe, versus less than 800 b/d in the Permian.
[4]Lynch, Michael C., "Investing for the Oil Price Collapse," Marketwatch.com, May 30, 2008.
[5]See Lynch, Michael C., "Drivers of Oil Price Volatility," Journal of Energy and Development, vol. XXVIII, no. 1, Autumn 2002.
[6]International Energy Agency, Oil Market Report November 2019, p. 17.
[7]https://www.api.org/news-policy-and-issues/american-jobs/economic-impacts-of-oil-and-natural-gas
[8]https://stateimpact.npr.org/pennsylvania/2019/06/27/gas-impact-fee-revenue-rises-to-7-year-high-boosted-by-stripper-wells/
[9]Lynch, Michael C., "Why Rapid Shale Production is a Perk," June 26, 2019.
[10]https://www.eia.gov/todayinenergy/detail.php?id=37732
[11]https://www.ferc.gov/industries/gas/indus-act/lng/lng-approved.pdf
[12]The Cactus II pipeline in the Permian, carrying 670 tb/d of oil and condensate, cost $1.1 billion. Total additions to Permian liquids capacity will have increased by roughly 3 mb/d from 2017 to end 2020, implying about $5 billion in costs total. Other investment, such as storage tanks, would add to this. https://pubs.spe.org/en/ogf/ogf-article-detail/?art=5828
[13]https://pubs.spe.org/en/ogf/ogf-article-detail/?art=5806 and https://www.kindermorgan.com/pages/business/co2/pipelines/wink.aspx.
[14]https://www.wsj.com/articles/manufacturers-face-new-threat-from-fracking-slump-11574083303?mod=searchresults&page=1&pos=6
[15]https://www.houstonchronicle.com/business/energy/article/fracking-2018-american-crude-oil-production-12524642.php
[16]https://www.timesonline.com/news/20171108/shell-officially-starts-construction-on-6-billion-ethane-cracker-plant
[17]Matthews, Christopher M., "What Would Happen if the U.S. Banned Fracking?" Wall Street Journal, 11/20/19, R6.
[18]International Gas Union, Wholesale Gas Price Survey, 2018 edition, p. 25.